

What is claimed is:

1. A taking lens apparatus comprising:

a zoom lens system that is composed of a plurality of lens units and that achieves zooming by varying distances between the lens units; and

an image sensor that converts an optical image formed by the zoom lens system into an electrical signal;

wherein the zoom lens system comprises:

a first lens unit that is disposed at an object-side end of the zoom lens system, that has a negative optical power as a whole, and that remains stationary relative to the image sensor during zooming of the zoom lens system;

a second lens unit that is disposed on an image-sensor side of the first lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an object side during zooming of the zoom lens system from a wide-angle end to a telephoto end; and

a third lens unit that is disposed on an image-sensor side of the second lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an image side during initial zooming from the wide-angle end to the telephoto end.

2. A taking lens apparatus as claimed in claim 1, wherein the third lens unit moves toward an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

3. A taking lens apparatus as claimed in claim 1, wherein the third lens unit

moves along a U-shaped trajectory convex to an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

4. A taking lens apparatus as claimed in claim 1, wherein the first lens unit includes an aspherical surface.

5. A taking lens apparatus as claimed in claim 1, wherein an aperture stop is disposed between the first and second lens units.

6. A taking lens apparatus as claimed in claim 1, wherein an aperture stop is disposed between the second and third lens units.

7. A taking lens apparatus as claimed in claim 1, wherein the zoom lens system includes an aperture stop that moves together with the second lens unit during zooming.

8. A taking lens apparatus as claimed in claim 1, wherein the zoom lens system includes an aperture stop that remains stationary relative to an image plane during zooming.

9. A taking lens apparatus as claimed in claim 1, wherein the third lens unit is composed of a plurality of lens elements.

10. A taking lens apparatus as claimed in claim 1, wherein the following condition is fulfilled:

$$2.5 < D_{\text{ref}} / Y_{\text{max}} < 4$$

where

$D_{\text{ref}}$  represents a sum of axial distances between an object-side optical component located immediately in front of the reflective member and an image-side optical component located immediately behind the reflective member; and

$Y_{\text{max}}$  represents a maximum image height.

11. A taking lens apparatus as claimed in claim 1, wherein the following condition is fulfilled:

$$1.0 < (f_t \cdot m_{2w}) / (f_w \cdot m_{2t})$$

where

$f_w$  represents a focal length of the zoom lens system as a whole at the wide-angle end;

$f_t$  represents a focal length of the zoom lens system as a whole at the telephoto end;

$m_{2w}$  represents an imaging magnification of the second lens unit at the wide-angle end; and

$m_{2t}$  represents an imaging magnification of the second lens unit at the telephoto end.

12. A taking lens apparatus as claimed in claim 1, wherein focusing is achieved by

moving the third lens unit.

13. A taking lens apparatus as claimed in claim 1, wherein only one lens element is disposed on an object side of the reflective member.

14. A taking lens apparatus comprising:

a zoom lens system that is composed of a plurality of lens units and that achieves zooming by varying distances between the lens units; and

an image sensor that converts an optical image formed by the zoom lens system into an electrical signal;

wherein the zoom lens system comprises:

a first lens unit that is disposed at an object-side end of the zoom lens system, that has a negative optical power as a whole, that includes a reflective member for bending an optical axis of the zoom lens system as a whole at substantially 90°, and that remains stationary relative to the image sensor during zooming of the zoom lens system;

a second lens unit that is disposed on an image-sensor side of the first lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an object side during zooming of the zoom lens system from a wide-angle end to a telephoto end; and

a third lens unit that is disposed on an image-sensor side of the second lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an image side during initial zooming from the wide-angle end to the telephoto end.

15. A taking lens apparatus as claimed in claim 14, wherein the third lens unit moves toward an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

16. A taking lens apparatus as claimed in claim 14, wherein the third lens unit moves along a U-shaped trajectory convex to an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

17. A taking lens apparatus as claimed in claim 14, wherein the first lens unit includes an aspherical surface.

18. A taking lens apparatus as claimed in claim 14, wherein an aperture stop is disposed between the first and second lens units.

19. A taking lens apparatus as claimed in claim 14, wherein an aperture stop is disposed between the second and third lens units.

20. A taking lens apparatus as claimed in claim 14, wherein the zoom lens system includes an aperture stop that moves together with the second lens unit during zooming.

21. A taking lens apparatus as claimed in claim 14, wherein the zoom lens system includes an aperture stop that remains stationary relative to an image plane during zooming.

22. A taking lens apparatus as claimed in claim 14, wherein the third lens unit is

composed of a plurality of lens elements.

23. A taking lens apparatus as claimed in claim 14, wherein the following condition is fulfilled:

$$2.5 < D_{ref} / Y_{max} < 4$$

where

$D_{ref}$  represents a sum of axial distances between an object-side optical component located immediately in front of the reflective member and an image-side optical component located immediately behind the reflective member; and  
 $Y_{max}$  represents a maximum image height.

24. A taking lens apparatus as claimed in claim 14, wherein the following condition is fulfilled:

$$1.0 < (f_t \cdot m_{2w}) / (f_w \cdot m_{2t})$$

where

$f_w$  represents a focal length of the zoom lens system as a whole at the wide-angle end;  
 $f_t$  represents a focal length of the zoom lens system as a whole at the telephoto end;  
 $m_{2w}$  represents an imaging magnification of the second lens unit at the wide-angle

end; and

m2t represents an imaging magnification of the second lens unit at the telephoto end.

25. A taking lens apparatus as claimed in claim 14, wherein focusing is achieved by moving the third lens unit.

26. A taking lens apparatus as claimed in claim 14, wherein only one lens element is disposed on an object side of the reflective member.

27. A camera comprising:

a taking lens apparatus including a zoom lens system that is composed of a plurality of lens units and that achieves zooming by varying distances between the lens units and an image sensor that converts an optical image formed by the zoom lens system into an electrical signal;

wherein the zoom lens system comprises:

a first lens unit that is disposed at an object-side end of the zoom lens system, that has a negative optical power as a whole, and that remains stationary relative to the image sensor during zooming of the zoom lens system;

a second lens unit that is disposed on an image-sensor side of the first lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an object side during zooming of the zoom lens system from a wide-angle end to a telephoto end; and

a third lens unit that is disposed on an image-sensor side of the second lens

unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an image side during initial zooming from the wide-angle end to the telephoto end.

28. A camera as claimed in claim 27, wherein the third lens unit moves toward an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

29. A camera as claimed in claim 27, wherein the third lens unit moves along a U-shaped trajectory convex to an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

30. A camera as claimed in claim 27, wherein the first lens unit includes an aspherical surface.

31. A camera as claimed in claim 27, wherein an aperture stop is disposed between the first and second lens units.

32. A camera as claimed in claim 27, wherein an aperture stop is disposed between the second and third lens units.

33. A camera as claimed in claim 27, wherein the zoom lens system includes an aperture stop that moves together with the second lens unit during zooming.



34. A camera as claimed in claim 27, wherein the zoom lens system includes an aperture stop that remains stationary relative to an image plane during zooming.

35. A camera as claimed in claim 27, wherein the third lens unit is composed of a plurality of lens elements.

36. A camera as claimed in claim 27, wherein the following condition is fulfilled:

$$2.5 < D_{ref} / Y_{max} < 4$$

where

$D_{ref}$  represents a sum of axial distances between an object-side optical component located immediately in front of the reflective member and an image-side optical component located immediately behind the reflective member; and

$Y_{max}$  represents a maximum image height.

37. A camera as claimed in claim 27, wherein the following condition is fulfilled:

$$1.0 < (f_t \cdot m_{2w}) / (f_w \cdot m_{2t})$$

where

$f_w$  represents a focal length of the zoom lens system as a whole at the wide-angle end;

$f_t$  represents a focal length of the zoom lens system as a whole at the telephoto

end;

m2w represents an imaging magnification of the second lens unit at the wide-angle end; and

m2t represents an imaging magnification of the second lens unit at the telephoto end.

38. A camera as claimed in claim 27, wherein focusing is achieved by moving the third lens unit.

39. A camera as claimed in claim 27, wherein only one lens element is disposed on an object side of the reflective member.

40. A camera comprising:

a taking lens apparatus including a zoom lens system that is composed of a plurality of lens units and that achieves zooming by varying distances between the lens units and an image sensor that converts an optical image formed by the zoom lens system into an electrical signal;

wherein the zoom lens system comprises:

a first lens unit that is disposed at an object-side end of the zoom lens system, that has a negative optical power as a whole, that includes a reflective member for bending an optical axis of the zoom lens system as a whole at substantially 90°, and that remains stationary relative to the image sensor during zooming of the zoom lens system;

a second lens unit that is disposed on an image-sensor side of the first lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole,

and that moves toward an object side during zooming of the zoom lens system from a wide-angle end to a telephoto end; and

a third lens unit that is disposed on an image-sensor side of the second lens unit with a variable aerial distance secured in between, that has a positive optical power as a whole, and that moves toward an image side during initial zooming from the wide-angle end to the telephoto end.

41. A camera as claimed in claim 40, wherein the third lens unit moves toward an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

42. A camera as claimed in claim 40, wherein the third lens unit moves along a U-shaped trajectory convex to an image side during zooming of the zoom lens system from the wide-angle end to the telephoto end.

43. A camera as claimed in claim 40, wherein the first lens unit includes an aspherical surface.

44. A camera as claimed in claim 40, wherein an aperture stop is disposed between the first and second lens units.

45. A camera as claimed in claim 40, wherein an aperture stop is disposed between the second and third lens units.

46. A camera as claimed in claim 40, wherein the zoom lens system includes an aperture stop that moves together with the second lens unit during zooming.

47. A camera as claimed in claim 40, wherein the zoom lens system includes an aperture stop that remains stationary relative to an image plane during zooming.

48. A camera as claimed in claim 40, wherein the third lens unit is composed of a plurality of lens elements.

49. A camera as claimed in claim 40, wherein the following condition is fulfilled:

$$2.5 < D_{ref} / Y_{max} < 4$$

where

$D_{ref}$  represents a sum of axial distances between an object-side optical component located immediately in front of the reflective member and an image-side optical component located immediately behind the reflective member; and  
 $Y_{max}$  represents a maximum image height.

50. A camera as claimed in claim 40, wherein the following condition is fulfilled:

$$1.0 < (f_t \cdot m_{2w}) / (f_w \cdot m_{2t})$$

where

- fw represents a focal length of the zoom lens system as a whole at the wide-angle end;
- ft represents a focal length of the zoom lens system as a whole at the telephoto end;
- m2w represents an imaging magnification of the second lens unit at the wide-angle end; and
- m2t represents an imaging magnification of the second lens unit at the telephoto end.

51. A camera as claimed in claim 40, wherein focusing is achieved by moving the third lens unit.

52. A camera as claimed in claim 40, wherein only one lens element is disposed on an object side of the reflective member.